THE MASTER ENVIRONMENTAL LIBRARY:
An Environmental Data Source for DOD Applications
http://www-mel.nrlmry.navy.mil

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ABSTRACT

The Master Environmental Library (MEL) is a World Wide Web (WWW) based data discovery and retrieval system providing access via a consistent single interface to oceanographic, terrain, atmospheric, and near space data bases and related tools residing in geographically distributed resource sites with arbitrary data base configurations and data formats. The key features of MEL are a consistent standard for metadata contents, a common user-friendly interface, a generic order/delivery system under resource site control, and use of standard transfer formats. In the Modeling and Simulation Resource Repository (MSRR), MEL provides access to the environmental domain.

1. INTRODUCTION

1.1 BACKGROUND: *THERE IS A NEED FOR AUTHORITATIVE ENVIRONMENTAL DATA IN DOD MODELING AND SIMULATION.*

Modeling and simulation (M&S) has become increasingly important in U.S. Department of Defense (DOD) activities, such as training, analysis, acquisition, research and development (R&D), test and evaluation, and mission rehearsal, because it offers lower cost and more extensive supplemental alternatives to the more traditional approaches to these activities. However, in the simulated world the natural environment must be included in a realistic, physically consistent, correlated way to achieve the full potential of M&S. This requirement is formally included as part of the DOD M&S Master Plan[1]. To help satisfy this requirement, the Defense Modeling and Simulation Office (DMSO) is funding the Master Environmental Library (MEL) Project, a joint project involving the Navy, Army, Air Force, and the National Imagery and Mapping Agency (NIMA), under the leadership of the Naval Research Laboratory.

1.2 VISION: *PROMOTE REUSE AND INTEROPERABILITY OF AUTHORITATIVE ENVIRONMENTAL DATA AND PRODUCTS FOR M&S THROUGH A ONE STOP ENVIRONMENTAL SHOP.*

MEL's vision is to enable uniform access to distributed data in arbitrary formats and to related tools to provide consistent common authoritative environmental representations and effects to various M&S users, war fighters, and other support activities. The data types can be grids, observational, raster, or vector. The environmental regimes include the atmosphere and near space, the ocean, and terrain. The data centers can be in DOD, other federal agencies, such as the National Oceanic and Atmospheric Administration (NOAA) and the National Aeronautics and Space Administration (NASA), and international sources. The data may exist "on the shelf" or may be made available through subscription when it is created. The tools include data fusion, visualization, and statistical processing. Products generated from the elemental data can be produced on a schedule, requested on demand, or produced interactively. The overall criteria for developing such a library infrastructure are to satisfy the high level DMSO goals of reuse and interoperability in the environmental domain, which are also appropriate goals for applications outside of M&S.

2. DATA DISCOVERY, RETRIEVAL, AND DELIVERY

2.1 THE PROBLEM AND A SOLUTION

When trying to locate authoritative environmental data, one finds that there is much already available and the amount is increasing rapidly, but the data are stored at various distributed data centers using different data bases and are delivered in different formats. Simply locating and retrieving the data for M&S can be a formidable problem. For geospatial data, which include data of the natural environment, such as the ocean, terrain, atmosphere, and near space, a common contents standard for *metadata* (data about data), such as the Federal Geographic Data Committee (FGDC) standard[2], is a powerful key to data discovery. With the rapid development of search engines and web browsers on the Internet, it became possible to create a common, consistent unified interface for parallel browsing of metadata at distributed data sites and for ordering the data itself. The actual details of data extraction, encoding in a standard delivery format, and delivery to the user, are hidden behind the user interface.

2.2 KEY COMPONENTS OF MEL'S APPROACH:

The key components of the MEL architecture are shown in Fig. 1. The user no longer has to deal with each

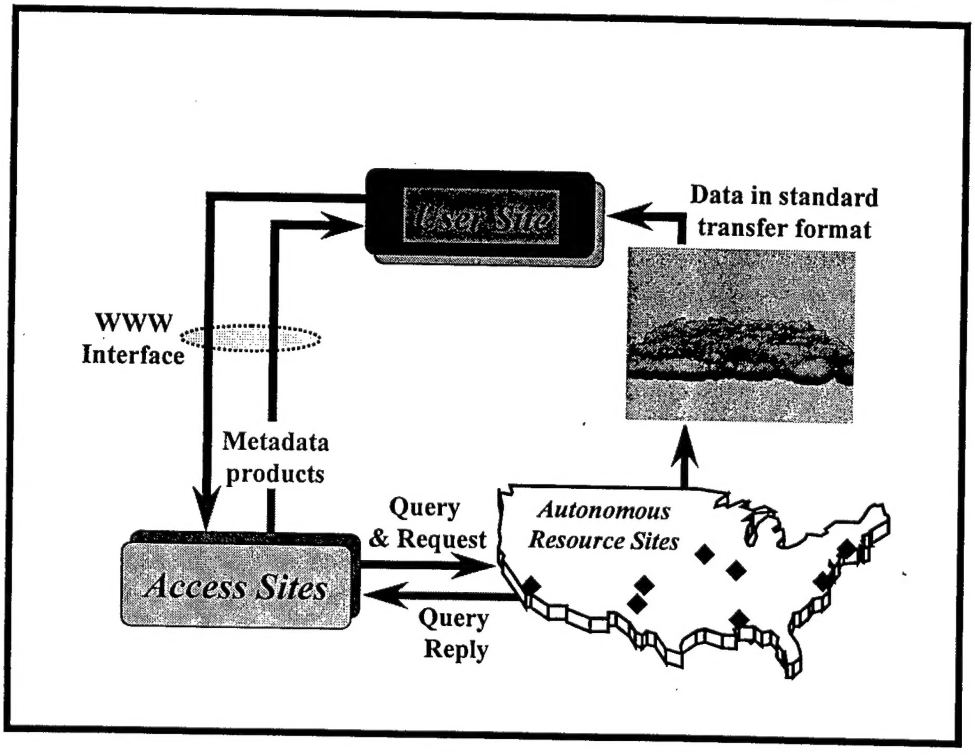

Figure 1. The different components of the MEL architecture are shown, indicating the key role of the access site as a common interface between the user and the data providers (resource sites).

provider separately, thus avoiding a variety of interfaces, methods of data querying and ordering, and different transfer formats. Such local variations are concealed behind the consistent single interface (access site). The data are left under the local control of the provider (resource site), who has only to create and maintain indexed metadata in the standard contents format for it to be searchable over the library system. The actual details of sending queries and requests from the access site, data extraction, encoding, and delivery are made generic to the greatest extent possible and customized as necessary for each resource site. Utilizing the fewest and most standard transfer formats possible and providing the corresponding decoders greatly simplifies the effort of the user to work with the data delivered. By using web technologies MEL exploits the

power of the market place for rapid technology development and de facto standards, for both unclassified and classified networks. This is consistent with the DMSO goals of reuse and interoperability of systems. As the technology evolves, it is straightforward to incorporate improvements into the basic architecture. Furthermore, the architecture is extensible to resource sites that can be processing sites for running models or tool applications. In addition to the original HyperText Markup Language (HTML) interface, a Java interface for querying the system and visualizing the results has been developed[3]. The current MEL sites are shown in Fig. 2.

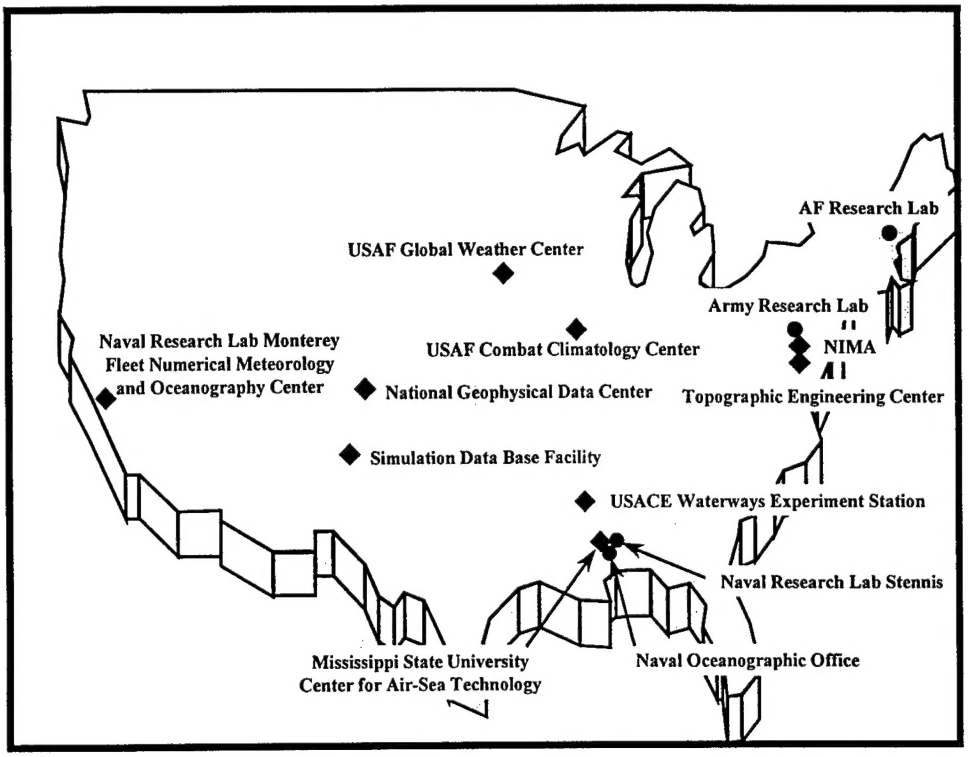

Figure 2. The current MEL sites are shown, where a diamond indicates an online site and a circle indicates a site not yet online.

3. PRODUCT GENERATION IN MEL

Most data providers in the MEL system provide basic environmental data such as winds, temperature, wave height, etc., though some offer products derived from these basic parameters. Because such products are often the information of most interest to M&S users or war fighters, the basic MEL architecture is being enhanced to provide some capability for product generation if resource sites wish to offer it. Here we describe several initial applications.

3.1 DATA ORIENTED APPLICATION

In this case, the order form for a given data set contains an additional section of possible processing options, such as creating graphics or computing statistics for every "field" selected, or a special list of "derived fields" could be presented as an option. In either case, the product involves only the selected data set, and processing occurs at the site where that data is stored.

3.2 PRODUCT ORIENTED APPLICATION

In this case the user searches for and selects a metadata record describing a field, which can be produced from one or more data sets. The data sets that can be used for generating the product are pre-determined and

the options on the order form are "input data set dependent". As a further extension, data sets can be located at one or more resource sites other than the product generator site.

3.3 INTERACTIVE APPLICATION

Here the user is connected via MEL to an "island of computation" where some interactive application is used on a selected data set. This could be generalized to include "shopping" for products. A further extension would be to allow data sets to be delivered to the interactive site prior to the user being connected there.

3.4 LOCAL APPLICATION

Developers outside of MEL could provide local applications to receive, manage, and work with data delivered from MEL. Examples of plug-in modules could be data interpolation, computation of derived fields, and data visualization. This, of course, would require strict version control on a potentially very complicated piece of software, and the user would need a machine capable of the necessary processing. It does, however, eliminate much of the load from MEL servers.

4. CONCLUSIONS

4.1 SIGNIFICANCE OF MEL

MEL is the first data discovery, retrieval, and delivery system that allows a user to query Navy, Army, Air Force, NIMA, and certain non DOD centers for the existence of geospatial data that satisfies the user's criteria, and to request either archived data or data that can be made available by subscription. The data can be from any of the natural environmental domains of terrain, ocean, atmosphere, and near space. The MEL system is also being transferred to a classified network.

4.2 FUTURE PLANS

The emphasis in FY98 will be on increased robustness of the architectural implementation and transition of independently developed tools and other applications to the system, providing enhancements for data manipulation, visualization, distributed computing, and product generators. The project expects to expand its customer base beyond M&S to include joint operational users who require access to distributed sources of geospatial data and to continue its coordination and collaboration with other library systems.

5. ACKNOWLEDGMENTS

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6. REFERENCES

1. Department of Defense, Under Secretary of Defense for Acquisition and Technology. "Modeling and Simulation (M&S) Master Plan". October 1995. <URL:http://www.dmso.mil/docslib/mspolicy/msmp/1095msmp/>

2. Federal Geographic Data Committee, Washington, DC. "Content standards for digital spatial metadata (June 8 draft)". 1994. <URL:http://www.its.nbs.gov/nbs/meta/meta.htm>

3. Alper, N. and Stein, C. "Geospatial Metadata Querying and Visualization on the WWW Using Java Applets". Proceedings, IEEE Information Visualization '96. PP 77-84, October 1996.